Clinical findings and treatment outcomes for cats diagnosed with Patent Ductus Arteriosus in the United Kingdom: 19 cases (2004-2012)

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Patent Ductus Arteriosus (PDA) is infrequently reported in cats and represents between 1-7.3% of left to right shunting cardiac congenital anomalies. The objective of this study was to report the presenting complaints, clinical examination findings, diagnostic findings, treatment outcomes and survival times in cats diagnosed with a PDA in the United Kingdom (UK). Medical records from three major UK referral centres were searched for cats that were diagnosed with PDA from January 2004 to December 2012. Data obtained for analysis included: signalment, clinical examination findings including murmur characteristics, diagnostic imaging findings, treatment outcomes and survival times. Nineteen cats were included in the analysis. The most common reason for referral was investigation of an incidentally detected heart murmur without clinical signs (13/19; 68%). Pulmonary arterial hypertension (PAH) was diagnosed in seven (37%) cats and those cats with PAH were significantly more likely to present with signs of disease ($P = .004$). Median survival time in cats that were diagnosed with PDA and died due to cardiac causes was 898 days (IQR 459-1011 days). The median survival time of those cats that had an additional congenital anomaly was significantly shorter to those cats without a congenital anomaly ($P = .008$).

Patent Ductus Arteriosus (PDA) is less frequently reported in cats than in dogs (Kittleson and Kienle 1998, Zook 1987). In two case series of cats with congenital left to right shunting cardiac anomalies only seven of 927 (<1%) and seven of 96 (7.3%) were diagnosed with PDA respectively (Kittleson and Kienle 1998, Liu 1977). The course of disease in cats is similar in dogs whereby left sided volume overload leads to congestive heart failure if the PDA is left untreated. In some cases an increase in pulmonary arterial pressure in response to the pulmonary over-circulation secondary to the large volume of left to right shunting may induce a pathological response in the pulmonary vasculature over time. Vascular changes include hypertrophy and intimal proliferation in the small and medium pulmonary vessels leading to a gradual narrowing of the pulmonary vessels and eventual pulmonary arterial hypertension (PAH) (Friedman and Silverman 2001, Kittleson and Kienle 1998, Oswald and Orton 1993). The PAH may become severe enough to reduce left to right shunting of blood through the PDA and in some cases reverse it – the Eisenmenger's physiology (Friedman and Silverman 2001, Oswald and Orton 1993). Despite a thorough understanding of PDA in dogs and cats, reports of outcomes particularly in cats are infrequent in the veterinary literature. A single multicentre case series has been published recently, which reported 28 cats diagnosed with PDA over a 21 year period (Hutton and others 2015). This retrospective study reported the clinical presentation and outcomes of cats treated surgically and medically at three referral/university practices in the United States. Another case-series of feline PDA describing a cohort of 21 cats from 3 separate referral centres in the United States was presented as a clinical communication at the American College of Veterinary Internal Medicine (ACVIM) congress in 2000 (Hitchcock and others 2000). The rest of the veterinary literature consists of single case reports or small case series (Allen 1982, Aoki and others 2013, Connolly and others 2003, Fiske 1980, Jeraj and others 1978, Jones and Buchanan 1981, Schneider and Hildebrandt 2003, Summerfield and Holt 2005). The purpose of this

study was to report the presenting complaints, clinical examination findings, diagnostic findings, treatment outcomes and survival times in cats diagnosed with a PDA in the United Kingdom (UK).

Materials and Methods

Medical records from three referral centres (XX, XX and XX) were searched for cats that were diagnosed with PDA from January 2004 to December 2012. For inclusion in the analysis the diagnosis had to be confirmed echocardiographically by a board certified (RCVS, ECVIM or ACVIM) cardiologist or a resident under the direct supervision of a board certified cardiologist. Data obtained for analysis included signalment, clinical examination findings including murmur characteristics, diagnostic findings (including radiographic and echocardiographic findings), treatment (medical or surgical), hospitalisation time, treatment outcome including post-operative echocardiographic findings and survival times. Echocardiography data were retrieved from the clinical record. Left sided standard measurements were determined from 2-dimensional (2D) images. From the right parasternal (RPS) long axis four chamber view, maximum left atrial diameter in systole (LAMax) (Smith and Dukes-McEwan 2012) and from the RPS short axis view, left atrium to aorta ratio (LA:Ao, end diastole) (Abbott and MacLean 2006) measurements were recorded. Left ventricular M-mode dimensions at chordae tendineae level included left ventricular internal diameter at the end of diastole ($LVID_d$) and the end of systole ($LVID_s$) were recorded, and fractional shortening (FS%) calculated. Changes of the right cardiac chambers were assessed subjectively from 2D images and recorded as a binary data (yes/no). This included right atrial dilation, right ventricular concentric hypertrophy, and right ventricular dilation. Spectral Doppler studies were used to determine regurgitation velocities of the tricuspid, pulmonic

and mitral valves as well as peak velocity of PDA flow. The presence of PAH was recorded as a binary data (yes/no) based on the direction and velocity of PDA flow and tricuspid or pulmonic regurgitation velocities, where present (in cats where concurrent pulmonic stenosis was excluded). The presence of significant PAH was arbitrarily defined as estimated pulmonary arterial systolic pressure of ≥50 mmHg (i.e. moderate or severe) (Kellihan and Stepien 2010). PAH was considered to be present in the following circumstances: (i) right to left or bidirectional PDA flow, (ii) where left to right flow was still present, but the systolic blood pressure to peak PDA flow velocity derived aortic-pulmonary pressure gradient (PG) (calculated using the modified Bernoulli equation; PG ≈ 4 x (velocity^2)) was <50 mmHg, (iii) in absence of pulmonic stenosis in cases with tricuspid regurgitation (TR), if the TR velocity exceeded 3.5 m/s (RV-RA PG >49 mmHg). Direction of flow in the PDA was recorded as left-to-right, right-to-left, bidirectional and it was timed as continuous or predominantly systolic. For the statistical analysis of flow velocities between different PDA flow directions, right-to-left and bidirectional shunting PDAs were grouped and compared to the left-to-right shunting PDAs. If echocardiographically visible, the diameter of PDA ostium as it entered the main pulmonary artery was measured. Surgical treatment was further assessed for technique (minimally invasive or open surgical occlusion procedure), intra-operative and post-operative complications. Telephone interviews with referring veterinary surgeons and owners were conducted to determine survival, cause of death and ongoing treatments where applicable. Survival time was calculated from the date of presentation to the respective referral centre to the date of death in days. If an exact date of death was not recorded, the 1st of the month was used as the date of death. Study approval was obtained from the clinical research ethical review committees at the respective institutions.

Statistical analysis

Statistical analyses were performed using commercial software (SPSS Version 21, IBM®, New York, USA and Minitab16, Minitab Incorporated, Pennsylvania, USA). Continuous variables were tested for normal distribution using the Kolmogorov-Smirnov test. Normally distributed data (bodyweight, respiratory rate, systolic blood pressure, PDA peak velocity, PDA ostium diameter and follow up time) were expressed as mean ± standard deviation and compared using unpaired two-tailed Student's T-tests. Data not meeting the hypothesis for normality (age and heart rate) was expressed as median (interquartile range; Q1-Q3) and compared using non-parametric tests (Mann-Whitney u-test). Survival analysis data were analysed using Kaplan-Meier plots and comparison of hazards by log rank (Mantel-Cox χ^2) test. Due to low case numbers individual survival times were reported with median (IQR). Values of $P \leq 0.05$ were considered significant for all analyses.

Results

Nineteen cats were diagnosed with PDA based on echocardiography and included in the analysis. The breeds of cats were Domestic Short Hair (n = 8, 42%), Domestic Long Hair (n = 4, 21%), Siamese (n = 3, 16%), Persian (n = 2, 11%), Ragdoll (n = 1, 5%) and Sphynx (n=1, 5%). Nine of the cats were females (7 entire, 3 neutered) and nine were males (3 entire, 6 neutered). The age and clinical examination data are presented in Table 1. The most common reason for referral was investigation of an incidentally detected heart murmur in a cat without clinical signs (13/19; 68%). The remaining six cats (32%) were referred because of clinical signs attributed to the PDA including weight loss, tachypnoea, lethargy, abdominal distension, collapse with excitement/exertion and smaller stature than littermates. Seventeen cats had details of thoracic auscultation recorded in the clinical notes: all had a heart murmur. The most common grade was grade 3/6 (n = 5) followed by grades 4/6 (n = 4), 5/6 (n = 4),

2/6 (n = 2) and 6/6 (n = 2) respectively. In six (35%) cats a continuous heart murmur was documented. Thoracic radiographs were performed in 12 cats: four (33%) had generalised cardiomegaly, three (25%) had right ventricular enlargement and one (8%) had severe left atrial enlargement. A pulmonary vascular pattern was present in seven (58%) of 12 cats. Only two cats had a lung pattern that was suggestive of congestive heart failure and both cats were considered to be in left sided failure. In three cats the pulmonary vascular pattern was the only radiographic finding with no change to the cardiac silhouette size or shape observed. Both cats with CHF were alive at the time of the analysis: one cat underwent surgical ligation of the PDA while the other was managed medically with diuretics.

Echocardiography

Echocardiography findings are summarised in table 2. In the 15 cats where the direction of flow through the PDA was recorded, the flow was left to right in 12 (80%), right to left in two (13%) and bidirectional in one (7%) cat. Changes of the right cardiac chambers were identified in seven (37%) cats, including five (26%) with right atrial dilation, seven (37%) with right ventricular hypertrophy and five (26%) cats with right ventricular dilation. All the cats with right sided changes had a combination of atrial and ventricular morphological changes seen on echocardiography. Left atrial enlargement was present in nine (53%) and left ventricular dilatation with eccentric hypertrophy documented in the majority of cats during diastole (81% cats) and systole (71% cats). The cats with increased end-systolic left ventricular internal diameter ($LVID_s$) (mean ± SD: 13 ± 4 mm) were inferred to have impaired left ventricular systolic function. Seven (37%) cats were diagnosed with PAH: three cats had bidirectional PDA flow and the remaining four cats had left-to-right shunting PDAs. Peak PDA flow was recorded in 14 cases: in the left-to-right shunting PDAs the mean

peak flow was 4.5 ± 0.9 m/sec while the mean peak flow was 1.7 m/sec in the one cat with a right to left shunting PDA with recorded data. If cats with left to right shunting and PAH were excluded, the peak PDA flow was 4.7 ± 0.9 m/sec. The PDA flow velocity in the cats with left to right shunting and a concurrent PAH was significantly lower at 3.9 ± 0.1 m/sec that those without PAH (P =.05). The cats with PAH were significantly more likely to present with signs of disease (i.e. lethargy) than those cats without PAH (P = .004). Six (32%) cats had one or more additional congenital cardiac abnormalities diagnosed: three had a ventricular septal defect (VSD), one had an atrial septal defect (ASD) and tricuspid valve dysplasia, one had an ASD, and one had mitral valve dysplasia. The presence of an additional congenital defect was not significantly associated with reason for referral (P = .92) but those with an additional congenital defect were presented at a significantly younger age (6 months) compared to 34 months in those cats with PDA only (P = .05). The PDA ostium was visualised in 13 (68%) of the 19 cats and where the diameter was measured (n = 12) the mean diameter was 2.3 ± 0.8 mm.

Treatment

Closure of the PDA was performed in 6 (32%) cats: an open surgical procedure with ligation of the ductus was done in five and transvenous coil embolization was performed in one. In the remaining 13 cats where records were available for review, two cats were not treated as the PDA was considered haemodynamically insignificant, and the cost of treatment was prohibitive for the owner. In another four cats, treatment was not performed due to right to left shunting (n = 2) and bidirectional flow within the PDA (n = 2). Surgery was performed via a left sided intercostal thoracotomy with ligation of the PDA. No intraoperative complications were encountered in the open surgical cases and a minor post-operative

147 complication was seen in one cat (removed sutures). Transvenous coil embolisation was
148 performed by use of MReye® Flipper® 5 mm 5 loop detachable embolization coil (Cook
149 Medical Europe Ltd) through a femoral venous access.

150

151 Outcome

152 At the time of analysis nine of the 19 cats (47%) were still alive, seven (37%) had died or
153 were euthanased and three (16%) were lost to follow up. Of the seven that died, three cats
154 died of causes unrelated to heart disease: two were hit by a car and one was attacked by dogs.
155 The median follow up time for the cats that were alive at time of analysis was 897 days (IQR
156 504-2078 days). Post-operative echocardiographic data were available for three of the six
157 cats that had surgical or interventional closure of the PDA: two cats that had surgical ligation
158 and one that had transvenous coil embolisation. Residual ductal flow was not evident in any
159 of the three cats, but one of the three cats was diagnosed with PAH, based on tricuspid
160 regurgitation velocity, which had not been documented pre-operatively. This cat was still
161 alive at the time of analysis after a follow up of 1867 days. Conversely one cat that was
162 diagnosed PAH pre-operatively underwent surgical ligation with resolution of the PAH on
163 follow-up examinations. This cat was still alive at follow up of 843 days.

164

165 The median survival time for all cats that died or were euthanased during the study period
166 was 220 days (IQR 15-898 days). If the cats that died or were euthanized for reasons other
167 than cardiac disease were excluded from the analysis, the median survival time was 898 days
168 (IQR 459-1011 days). Of the six cats that had surgical occlusion of the PDA performed, two
169 died or were euthanized (33%), three were still alive (50%) and one was lost to follow up

(17%). Of the 13 cats did not have closure of the ductus, five died or were euthanased (39%), five were still alive (39%) and three were lost to follow up (23%). The two cats that died in the group of cats that had surgical occlusion, one was hit by a car and the other was attacked by dogs with a survival times of 220 and 30 days (median 30 days; IQR 30-220 days) respectively. The five cats that did not have surgery and died or was euthanased during the study period had survival times of 9, 15, 101, 898 and 1011 days (median 459 days; 15-898 days). The difference between median survival times between the group of cats that had surgical occlusion of the PDA and those that did not was not statistically significant ($P = .43$) (figure 1). All the cats that died or were euthanased for causes related to heart disease did not have surgical occlusion of their PDA.

Seven cats (37%) were diagnosed with PAH. At the time of analysis three of the seven (43%) were still alive, three had died or been euthanased (43%) and one was lost to follow up (14%). In the three that died: one was euthanased at 15 days after presentation while the other two died due causes related to cardiac disease at 898 and 1011 days respectively. The three that were still alive were so at 843, 623 and 384 days of follow up respectively (median 623 days). In 12 cats that did not have PAH diagnosed at presentation: four had died or had been euthanased (33%), six were alive (50%) and two were lost to follow up (17%). The cats that had died: two died after being hit by a car at 9 and 220 days, one after being attacked by dogs at 30 days and one after 101 days due to causes related to cardiac disease. In the six that were alive were so at 371, 897, 1867, 2009, 2147 and 3119 days of follow up respectively (median 1938 days). The median survival times for the group of cats with PAH was 898 days (IQR 15-1011 days) compared to 30 days (IQR 9-101 days) for those cats without PAH (figure 2). This difference was not significant ($P = .174$). However if the cats that died due to causes unrelated to cardiac disease were excluded then a comparison could not be made due only

one cat remaining in the group of cats without PAH. One cat with PAH had surgical occlusion of the PDA performed while the remaining six cats did not. The cat with pre-operative PAH died due to causes related to cardiac disease after 1011 days. In the remaining six cats that had PAH and did not have surgical occlusion of the PDA, three had right to left shunting PDAs, one was bidirectional and two had left to right shunting PDAs. The three cats that had left to right shunting PDA's and did not have surgery: two were hit by car nine and 220 days after presentation respectively while the third cat was alive at a follow up of 2009 days. There were no details in the clinical notes for any of three cats with PAH and left to right shunting PDAs as to why surgery was delayed or not undertaken.

In the seven cats that died or were euthanized, two had other congenital cardiac anomalies (29%). The survival times for those without additional cardiac congenital anomalies were 30, 101, 220, 898 and 1011 days (median 459 days; IQR 220-898 days). Of the two cats with an additional congenital cardiac anomaly one was euthanized due to causes related to cardiac disease 15 days post-operatively and the other was hit by car nine days post-operatively. The median survival time of those cats that had an additional congenital anomaly was therefore 8 days (IQR 8-15 days) and was significantly different to those cats without a congenital anomaly ($P = .008$) (figure 3). Two of the cases that had an additional congenital anomaly had surgical occlusion of the PDA: one cat was still alive at the time of analysis with a follow up of 1867 days and the other lost to follow up.

Discussion

The present study includes data from 19 cats that were diagnosed with PDA at three referral centres in the UK. To the authors' knowledge this is the second largest series of cats that has been described in the veterinary literature and the only one reporting the data of the cats in the UK. Most of the literature on feline PDA to date consists of case reports or small case series dealing with specific manifestations of the disease or specific treatment methods (Aoki and others 2013, Connolly and others 2003, Schneider and Hildebrandt 2003, Summerfield and Holt 2005). In a clinical research abstract 21 cases were reported over a 3-12 year period at 3 referral centres in the United States (Hitchcock and others 2000). In that series 86% of cats were presented less than 1 year of age in comparison to 57% of cases in the present study. Age at presentation was not reported in a recent study reporting 28 cases of PDA in cats that compared those that were managed surgically to those that were not (Hutton and others 2015). The majority of cases (67%) in the Hitchcock and others' (2000) case series presented for investigation of clinical signs whereas only 32% and 35% of cases presented for investigation of clinical signs in the present study and the Hutton and others' (2015) study respectively. The exact cause for the major difference between the Hitchcock and others (2000) and the present study's group of cats is unclear. In the current study the gender distribution was even (nine females and nine males), which is similar to a recent study that found that 54% were female and 46% were male (Hutton and others 2015). This is in contrast to a study of long term outcomes in dogs with PDA, where females outnumbered males by 3:1 (Saunders and others 2014). The incidence of a concurrent congenital cardiac anomaly in cats appears to be relatively high - in our study it was 32%, similar to the findings of Hutton and others (2015) who reported the concurrent congenital defects in 26% of the cats with PDA. This contrasts to what has been reported in dogs where the incidence was 9% (Saunders and others 2014).

The present study found that the median survival time for all cats diagnosed with PDA (treated or untreated) that died due to cardiac disease was 898 days. Interestingly, although not statistically significant, the cats that did not have surgical occlusion of the PDA lived longer (459 days) than those that did have their PDA treated surgically (30 days) (figure 1). A more detailed analysis within the group that had surgery was not possible as the cats that died after the PDA was occluded did so due to non-cardiac causes (hit by car or attacked by dogs). Thus after exclusion of these cats from the analysis no cats died within the follow up period due to cardiac causes that had surgery. One may argue that surgery therefore may be a survival benefit but conversely it is possible the cats with a traumatic cause of death suffered this due to reduced activity capacity. This warrants further study. Hutton and others (2015) found that the median survival time for cats that did not have surgery was 45 months (1350 days), which is almost twice of that found in the present study. The median survival time for those cats that did have surgery was not calculable in the Hutton and others' (2015) study but it was not significantly different ($P = .41$) from the group of cats that were managed without surgery. The survival data in the present and the Hutton and others' (2015) studies is in stark contrast to what has been reported in dogs where there was a statistically significant difference found between dogs that had their PDA surgically occluded and those that were managed medically (Saunders and others 2014, Van Israel and others 2003). Median survival times ranged from 1800 days for dogs that were managed medically and 753-3030 days for those that had surgical occlusion of their PDA respectively (Saunders and others 2014, Van Israel and others 2003). The distribution of dogs less than a year of age in the Van Israel and others (2003) study was similar to the present report where 45% of dogs were presented older than 1 year of age. This lends to a more direct comparison between the species and from the present study it suggests that cats do not survive as long as dogs.

Pulmonary arterial hypertension was a frequent finding in our population with 37% of cats presenting with PAH. This is vastly higher than the incidence in dogs, where only 3% of the population studied presented with PAH secondary to PDA (Saunders and others 2014). The incidence of PAH was also higher in the present study in comparison to a recent study of cats (Hutton and others 2015). Hutton and others (2015) found an incidence of 8% of PAH in their population of 21 cats. The difference between the two cat populations is unclear. In one case undergoing surgical ligation of the PDA, PAH resolved on follow-up, suggesting it was reactive to the pulmonary over-circulation, rather than reflecting irreversible remodelling of the pulmonary vasculature. Conversely, PAH was diagnosed subsequent to PDA closure in another cat, consistent with pulmonary vascular changes. Both histopathological lung changes on biopsy and resolution of PAH following PDA closure have been reported in a single cat (Novo-Matos and others 2014). Survival times comparisons between the cats that had PAH and those did not were not significantly different but interestingly the cats with PAH appeared to live longer (figure 3). However only one cat in the group of cats that did not have PAH died due to causes related to cardiac disease and therefore more detailed analysis and conclusions cannot be made respectively. In the present study PAH was significantly associated with reason for referral where the cats with PAH were more likely to present with clinical disease (other than a murmur) rather than investigation of a murmur. Risk factors that have been found to be negatively associated with probability of survival after surgical treatment of left to right shunting PDAs in dogs were age, weight, pre-operative lethargy, pre-operative treatment with angiotensin-converting enzyme inhibitors and right atrial dilatation on radiographs at the time of surgery (Bureau and others 2005). Cox regression analysis was not performed on the present study's data due to the relatively low case numbers meaning that the results of the analysis would not be reliable.

The main limitations of the present study were that it was retrospective in nature: data was reliant on accurate record keeping, inevitable missing data, multiple clinicians involved in performing tests such as echocardiography and a limited number of cases. The present study was a multi-centre collaboration where most of the referral centres within the United Kingdom that had either a board certified surgeon or cardiologist were invited to participate. Only three centres were able to contribute data that was used in the analysis and overall only 19 cases were able to be included. This was a similar finding in a recent study where three centres in the United States were able to contribute 28 cases over a 21-year period. This again highlights the rarity of PDA diagnosed in cats in comparison to dogs. This may reflect in some way selection bias where some cats with low-grade murmurs that are asymptomatic are not referred for investigation. Similarly there may be cats with more balanced or right-to-left shunts that the murmur is not detectable. Therefore the incidence of PDA in cats in the UK may be very different to what is presented here. Due to the retrospective nature of the data collection, there were inevitable gaps in the data set that adds doubt to the statistical conclusions however this study adds more cats to the existing literature.

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360 Table 1: Clinical data on cats that were diagnosed with PDA

Parameter	N	Median (range) or Mean ± stdev	IQR (Q1-Q3)
Age (months)	19	11 (3-90)	4-37
Weight (kg)	17	2.9 ± 1.1	1.9-4.0
Heart rate (beats per minute)	15	169 (120-200)	160-180
Respiratory rate (breaths per minute)	9	42 ± 17	30-50
Systolic blood pressure (mmHg)	5	128 ± 20	111-129

361 stdev – standard deviation; IQR – interquartile range; Q1 – first quartile; Q3 – third quartile

362

363 Table 2: Echocardiographic measurements for cats diagnosed with PDA where values were
364 available for analysis.

Variable	N	PDA case data	IQR (Q1-Q3)	Reference feline values	% cats outside of reference range
LAMax (mm)	17	16.1 ± 3.9*	12.7-19.1	< 16[3]	53
LA/Ao ratio	16	1.4	1.2-1.7	1.13-1.68[2]	25
LVIDd (mm)	16	18.0 ± 5.6*	15.3-21.3	12.6 ± 1.2[1]	81
LVIDs (mm)	14	11.1 ± 4.6*	7.3-12.8	7.7 ± 1.6[1]	71
FS (%)	14	38.8 ± 9.6	32.5-42.3	39 ± 10[1]	50
PDA peak flow (m/s)	14	4.3 ± 1.2	3.6-5.2	NA	NA
PDA ostium diameter (mm)	12	2.3 ± 0.8	2-2.8	NA	NA

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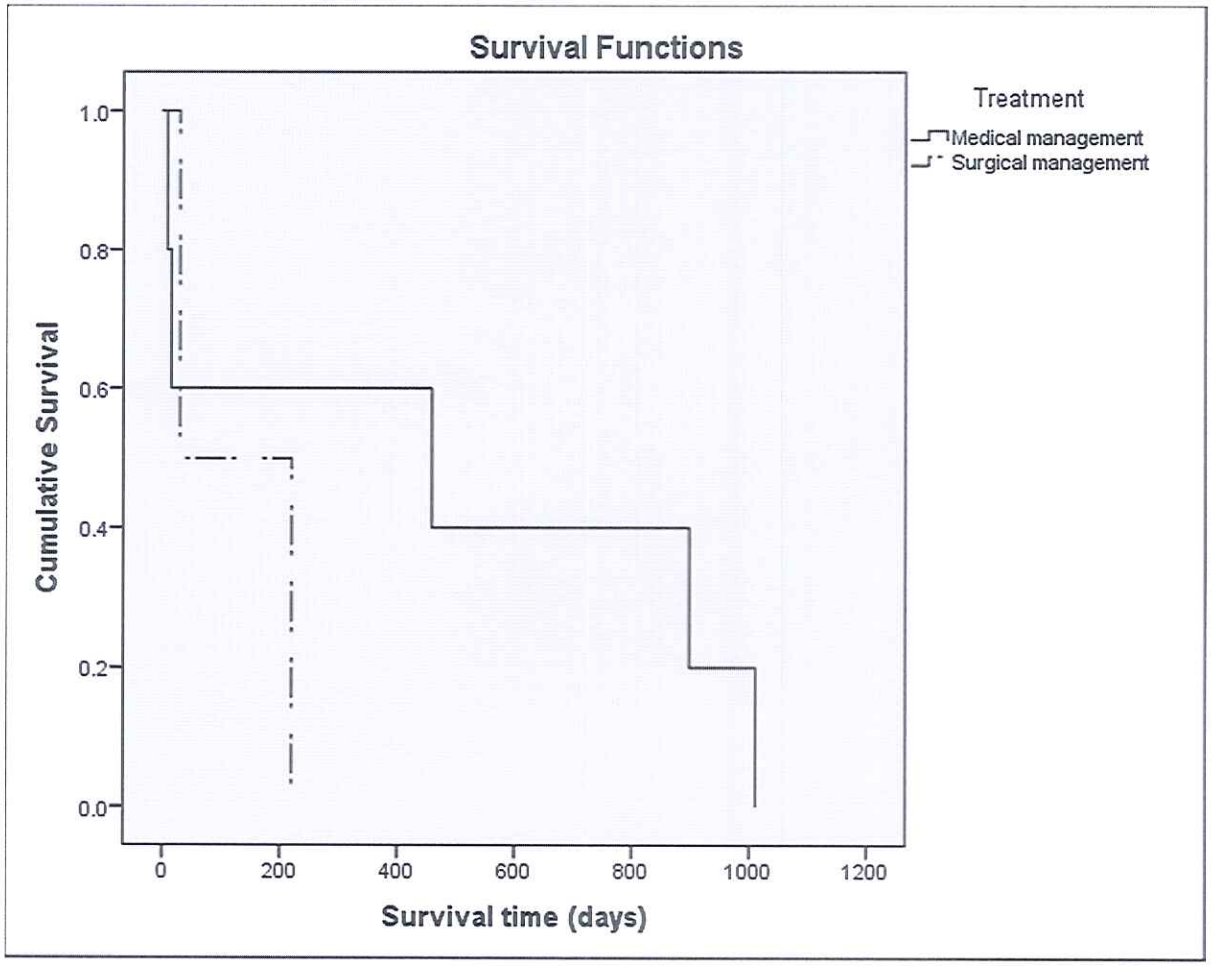
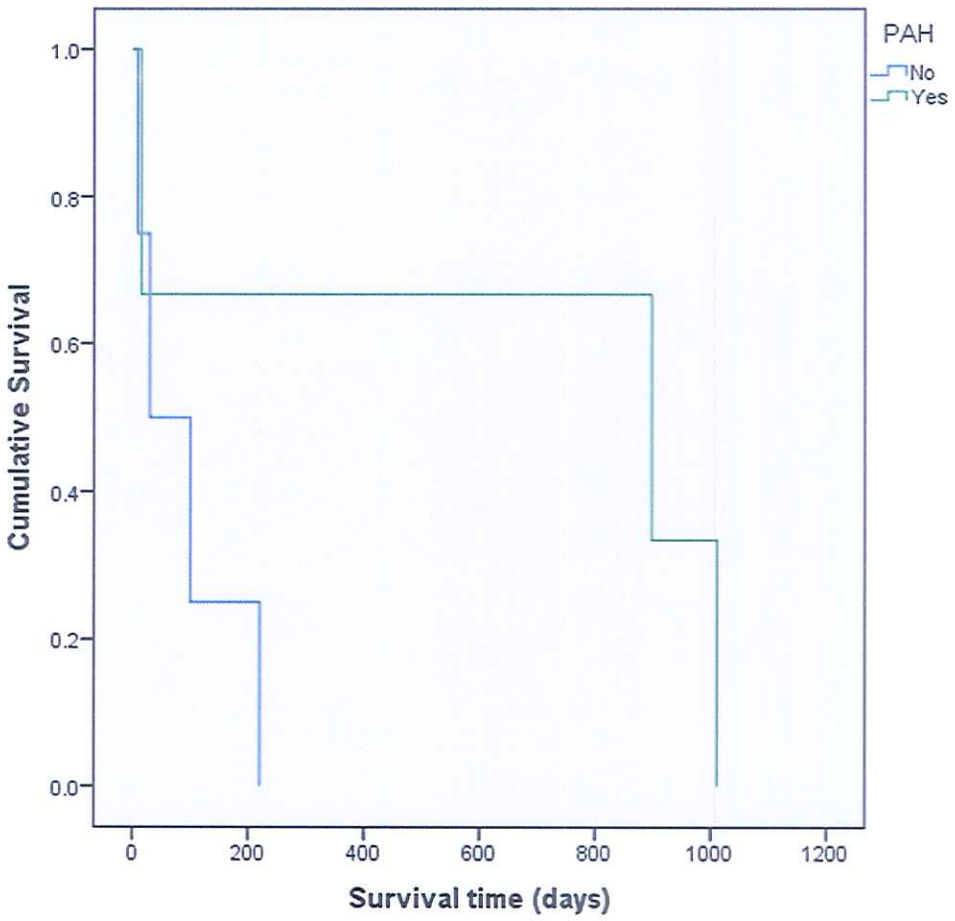
366 Patient data is in mean±sdev or median. IQR – interquartile range; Q1 – first quartile, Q3 –
367 third quartile. LAMax = maximum left atrium diameter. LA/Ao = left atrial to aortic
368 diameter ratio. LVIDd = left ventricular internal dimension in diastole. LVIDs = left
369 ventricular internal dimension in systole. FS = fractional shortening.

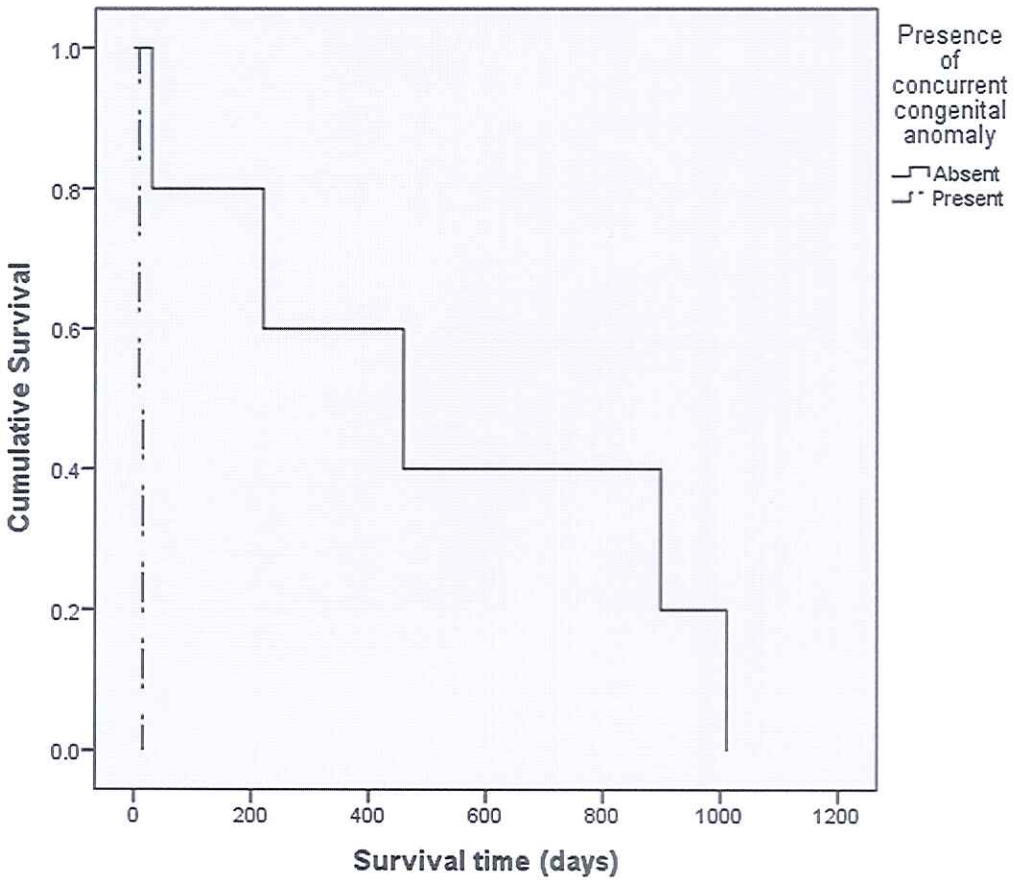
370 Reference feline values:[1]DeMadron and others (1985); [2]Abbott and MacLean (2006), [3]Smith
371 and Dukes-McEwan (2012)

372 *denotes those values outside reference range

373


Survival Functions
Treatment
Medical management
Surgical management
Cumulative Survival
1.0
0.8
0.6
0.4
0.2
0.0
0
200
400
600
800
1000
1200
Survival time (days)


PAH
No
Yes
Cumulative Survival
1.0
0.8
0.6
0.4
0.2
0.0
0
200
400
600
800
1000
1200
Survival time (days)


Cumulative Survival
1.0
0.8
0.6
0.4
0.2
0.0
0
200
400
600
800
1000
1200
Survival time (days)
Presence of concurrent congenital anomaly
Absent
Present